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ABSTRACT

Major considerations for efficient resource use in organizing and providing rural service systems include analysis of the supply and demand conditions for services in a dynamic rural economy, projection of economic factors influencing supply and demand conditions for rural services, and physical planning for rural services to meet efficiently the projected demand with restricted and efficient resource use. "Economic concepts of demand constitute an essential element in planning and organizing rural public service systems. The demand for services can be related to consumer costs and population characteristics of a specific area. The influence of price as a device for allocating resources needs to receive more attention than has been the case in the past. Autonomous changes in the broader social and political arenas of the state and nation affect the precision with which the demand for services in a region may be projected. It is essential that an accurate analysis be made of an area's potential for growth or decline for purposes of planning for future as well as current service needs." Included along with the text of the paper are 1 table (listing 7 public services, their output measure, and possible output quality measures) and a 9-item reference list. (MJB)

# Organization of Public Service Delivery Systems for Rural Areas: Concepts and Measures*

by

Lonnie L. Jones**

Solutions to problems in the organization of service delivery systems for rural areas require the use of concepts and measures from numerous scientific disciplines. Relevant concepts from sociology, political science, and other disciplines must be brought to bear on these problems. Within this broad framework, economic concepts and measures have a unique contribution to make. And, as an economist, my preoccupation here is with economic concepts and measures such as efficiency of resource use, equity, production and other economic concepts central to the supply of and demand for rural public services. I recognize that the inputs from other disciplines are highly relevant, but discussion of these is probably best left to the professionals of those disciplines.

The central theme of this paper is that the basic economic concepts and many of the measures utilized by economists in analyzing the organization and operation of firms in the private sector can also be applied to problems in the organization and provision of public services for rural areas.

If our purpose is to provide desired public services to rural areas as efficiently as possible, then the study of how to supply such services for rural areas is a logical area of inquiry for economists to apply their theoretical concepts and analytical tools. There are important economic issues in the organization of service delivery systems that are very close in concept to the kinds of problems that are traditional for economists.

It may be well to remind ourselves that economics is defined as the science of allocating scare means among competing ends to satisfy those ends as fully as possible. Further, Eidman and Walker [2] remind us that the delivery of each rural public service is a resource using activity whose objective is to satisfy wants and enhance consumer welfare. Hence, there is little basic, conceptual difference from the economic decision framework relevant to the production of private goods and services, although our attention must turn from the

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firm to the community, county or rural area as the relevant decision-making unit. The central economic issue is quite similar - how may limited resources be organized and allocated to accomplish the community's goal or goals. Ultimately, these community goals are to improve utility or welfare. Immediate goals may be to improve the quality and availability of community services, increase income or more jobs. Hence, implied in this discussion is a direct link between these immediate ends of better services and ultimate goals of increased utility.[1] While there is a direct link between better public services and welfare, secondary effects of increased business investment, growth and development as a result of the efficient provision of community services are also important considerations.

It has been stated elsewhere that there are three major considerations in the efficient provision of community services [6]. These are: (1) an analysis of the supply and demand conditions for services in a dynamic rural economy, (2) projection of economic factors influencing supply and demand conditions for rural services and (3) physical planning for rural services to efficiently meet projected demand with restricted and efficient resource use. Each of these areas provide a challenge for economists to apply their concepts and tools.

## Demand for Rural Public Services

The analysis and projection of the demand for services in rural areas are essential elements in the organization of delivery systems. Since the construction of service facilities such as schools, hospitals, water and sewage systems, etc., requires significant fixed, capital investments, it is critical that future as well as current needs and demand be taken into account in planning and organizing these systems. The demand for services within a rural area may be expressed as a function of the area's population, location, income and other characteristics and the cost of the service to consumers.

Traditionally, future use of a service has been projected by utilizing population projections in conjunction with current per capita use rate estimates. This method actually yields a projection of future requirements that will materialize only if the current use rate of the service does not change. We need to replace the projection of service requirements at current use rates with projection of actual demand for the service. Current service use rates represent only a single point (at existing prices) on the consumer demand schedule for a service. For those services that may be price responsive, such as public transportation and medical services, the entire consumer demand schedule needs to be considered in projecting future aggregate demand. For instance, if the provision of a service is possible only at a higher price to consumers and if the demand for the service is price

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[1] It may be argued the link between these lower-order ends such as better services and community utility is no more obscure than that between increasing farmer's profit and his utility [8].

responsive, projected requirements using current use rates may exceed demand and overinvestment with respect to the efficient use of resources may be the result.

The use of some other public services such as schools, where use is required by law, is unresponsive to price change. In these cases, simple population projections will likely be sufficiently accurate for planning purposes. However, even for services that are unresponsive to price change, shifts in per capita demand may occur such that projections become inadequate. In some cases, these shifts may be quite abrupt. For example, the creation of federal assistance for medical services for the aged and others shifted the demand for medical services and facilities upward sharply. Since assistance was provided specifically for medical services, this shift was probably greater than would have resulted from a comparable increase in per capita income. Other factors such as new regulations that limit pollution or establish minimums for water quality also have the effect of changing the per capita demand for certain services. All such changes compound the problem of projecting service demand. Economic concepts of collective demand and consumer surplus are applicable and for some services traditional utility concepts may be applied. But, we will probably need to turn to non-static planning techniques in some cases.

One approach would be to accept legal service minimums as a measure of need or demand. On the other hand, development enthusiasts for a community are likely to want to "think big" in planning for services sufficient to stimulate growth [2]. The choice may be situation specific. The "think big" approach can lead to overinvestment unless the area does in fact experience substantial population increase. Underinvestment may be just as serious in other instances. What is needed is a complete analysis and projection of underlying economic and social factors of the area to determine its likelihood of growth or decline and consequent future demand for public services. Input-output and economic growth models may be relevant to this analysis. Recent economic-ecologic models will prove useful in projecting the demand for some services.

## Estimation of Production and Cost Functions

Agricultural economists who are accustomed to estimating production and cost functions for crops and farm firms, will readily recognize the need for and usefulness of these concepts in organizing service delivery systems in rural areas. However, the transfer from private firm to community problems and the application of input-output relationships to the provision of rural public services presents some significant methodological and measurement problems. We are familiar with measuring output of farms in easily quantifiable units such as bushels or bales. Measurement problems increase in complexity when we turn to public services. What is the relevant output measure for a school? a hospital? or, a refuse collection system? The difficulty arises in specifying quality dimensions and in incorporating these into the estimation procedure so that both quality and quantity are

reflected in output levels resulting from alternative input combinations. We should, of course, recall that the question of quality has never been fully resolved even in farm firm production and cost functions. Instead, it is assumed (conveniently) that the variance of quality around a specific output-input combination is insignificant. We do not enjoy this convenience for many of the services under consideration, and measurement of quantity and quality of output is probably the single most important obstacle to the general application of production economics concepts.

Some public services and possible measures of their output are presented in Table 1. These are borrowed from Eidman and Walker [2] and are presented here as suggestions for further development. For some services, such as water treatment and refuse collection, the quality dimension of output does not appear difficult to overcome. In others, however, such as hospital services, adequate measures are yet to be developed. The use of "number of beds per 1000 population" is clearly insufficient as a measure of quality of hospital services.

The difficulties of measuring both quantity and quality of output will need to be overcome in the development of cost-effectiveness evaluation of service delivery systems. Some of the measures presented in Table 1 have been used in previous studies with apparent success [9]. While further refinement is needed, the problem may not be much more difficult than that for some agricultural production and cost functions.

## Production functions

Hirsch [4] suggests that public service production functions may be specified as follows:

$$\text{output} = f(Q, I, S, T)$$

where:

Q = quality factors of the service
I = input factors
S = service conditions affecting input requirements
and T = state of technology

Input factors for the equation could be disaggregated, at least, into labor and capital inputs, and further disaggregation would likely be desirable. Service conditions include numerous demographic, socio-economic, physical, financial, political and institutional factors related to the ease of providing a given quantity and quality of service. Alternative technological methods used in the system design would be important in some studies. The inclusion of quality variables (Q) on the right-hand side of the estimating equation allows quality variation in the dependent variables to be separated out.

## Cost functions

Microeconomic cost concepts as used in agricultural firm analysis are also applicable to the provision of public services. Given the public service system production function, such as that specified by

Table 1. Some Public Services and Possible Measures of Their Output

| Type of Service | Output Measure | Possible Output Quality Measures |
|---|---|---|
| Water Treatment and Distribution | Cubic Foot or Acre Foot Delivered | Physical & Biological Properties; Uniformity of Water Pressure; Speed of Repair Service |
| Refuse Collection | Ton, Cubic Yard or Container | Collection Frequency; Pickup Location |
| Police Protection | City Block or Square Mile Protected | Crime Rate Index |
| Fire Protection | City Block, Square Mile or Number of Homes Protected | Response Time: Average Annual Fire Loss per $1,000 of Assessed Value |
| Hospital Services | Patient Days in Hospital | Number of Beds per 1,000 Population |
| Schools | Average Daily Attendance | Average Achievement Test Scores; Absenteeism; Drop-out Rate |
| Libraries | Number of Persons Served | Selection of Books; Availability of Books; Reading Room Facilities; Reference Service, and Location |

Source: Vernon Eidman and Odell Walker, "The Role of Production Economists in Rural Development Research," Journal Article _____ of the Agricultural Experiment Station, Oklahoma State University, Stillwater, November, 1971.

Hirsch, the average unit cost function for the service system can be estimated. Or, cost functions may be estimated directly. The unit cost of a given service will be affected by the quantity and quality of the service, prices of inputs, and technology. Given an objective of minimizing costs of a specific quality and quantity of public service, we must be careful to include private as well as public or agency costs in our functions. Transportation costs and commuting time are examples of private costs that may vary with alternative service systems. These need to be estimated and included in the analysis to avoid cost shifting from the public to the private sector without reducing overall social costs.

Relationships among services also need to be considered in estimating cost functions. Both complimentary and substitution relationships exist among services, and when considering a set of services local decision makers are faced with a variety of factor-factor, product-product and factor-product relations. For example, public funds expended for schools reduce the amount available for hospitals. But on the other hand, more recreational and cultural services and facilities may reduce the cost of police protection and improved water systems may cut the need for some medical services. These are not unlike relationships encountered in economic analysis of farm firms.

## Economies of size

The estimation of cost functions for a given public service immediately and logically leads to the question of economies of size in providing the service for a large rural area. This involves estimating annual average costs for alternative facility and service systems with varying output levels. For example, we are concerned in East Texas with the economies associated with a multi-county solid waste management system. A comparison of short-run average costs for varying sizes of areas served (or tons managed) will provide estimates of economies of size in providing the service. This concept is equally applicable to other public services and it has been applied with success in previous studies [3,5]. Again, it is critical in such an analysis that the quality of service be considered and that private costs be included in the cost functions. Moreover, the need for interdisciplinary collaboration will likely become critical here since increasing the population served by a service system will likely necessitate cooperation among several communities and local governmental units.

## Optimum service levels and combinations

The application of operations research techniques such as linear programming, dynamic programming and simulation is a logical extension of production and cost function concepts in organizing rural service systems. Conceptually, such models may be applied to select the optimum level and combination of services for a community or area. One envisions, for example, specifying a linear programming model with the objective of determining the least cost combination and levels of a

set of public services subject to constrainst on the minimum level of each service desired. While such models are conceptually sound, measures and data for assigning the necessary weights, such as relative values of alternative services to the community are yet to be developed. Such models do, however, hold immediate promise for certain suboptimization schemes for a specific service. For instance, separable linear programming has been used in Oklahoma to determine the least cost combination of school size and internal schooling organization for areas of alternative student densities [9].

Network analysis, transportation and plant location models appear to be well suited to certain service system problems such as determining the least cost location for specific service plants and facilities.

Data sources and estimation techniques

Problems of adequate data will likely continue to plague all social scientists in dealing with problems of delivering rural services. The economist's experience with the use of economic engineering data, proxy variables and record data will be helpful. But, we need to identify and tap data sources available from our newly acquired clientele such as state agencies, professional experts, insurance companies and other sources. In Texas, at least, considerable data on services exist from varied sources and we are attempting to assimilate and evaluate this information before launching into the collection of massive amounts of primary data.

Numerous estimation procedures are available for use in problems of providing rural services and, with continued growth in computer software, more may be expected. But, economists have relied chiefly on economic engineering and least squares estimation procedures in the past, and these probably will continue to be popular estimation techniques in rural public service research.

## Summary and Conclusions

Most agricultural economists have devoted most of their research time in the past to problems in commercial agriculture. But, the economic concepts utilized in this research are not limited to farm firms or private industries. Concepts of economics may also be applied effectively to problems of efficient resource use in organizing and providing rural service systems. Major considerations include (1) analysis and projection of factors influencing supply and demand for rural services and (2) physical planning for rural services to efficiently meet projected demand with limited resources.

Economic concepts of demand constitute an essential element in planning and organizing rural public service systems. The demand for services can be related to consumer costs and population characteristics of a specific area. The influence of price as a device for allocating resources needs to receive more attention than has been the

case in the past. Autonomous changes in the broader social and political arenas of the state and nation affect the precision with which the demand for services in a region may be projected. It is essential that an accurate analysis be made of an area's potential for growth or decline for purposes of planning for future as well as current public service needs.

Basic economic concepts involved in the estimation of production and cost functions, economies of size and optimum service levels and combinations are also important areas of inquiry. Measures of output and quality of output present significant problems for some services. Nevertheless, the concepts have been applied with success in a number of previous studies and their potential for contribution seems to be rather high.

The economic concepts and measures discussed in this paper by no means constitute an exhaustive array of those relevant to the organization of rural public service systems. Others are important and new concepts and measures may well be required.

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